

Remarks

Reconsideration of this Application is respectfully requested.

Upon entry of the foregoing amendment, claims 1-15, 17-25 and 27-31 are pending in the application, with claims 1, 11, 12, 13, 14, 15, and 27 being the independent claims. Claim 16 has been cancelled without surrender of or prejudice to the subject matter contained therein. These changes are believed to introduce no new matter, and their entry is respectfully requested.

Based on the above amendment and the following remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Rejections under 35 U.S.C. § 103

Claims 1-4, 6-7, 9-15, 17-19, and 21-31 stand rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over U.S. Pat. No. 5,541,026 to Matsumoto ("Matsumoto") in view of U.S. Pat. No. 6,404,482 to Shiraishi ("Shiraishi"). Applicants respectfully traverse.

Regarding claims 1, 11, 12, and 13, it would not have been obvious to one of skill in the pertinent art to combine the disclosure of Matsumoto with the disclosure of Shiraishi to produce the claimed invention. Matsumoto is directed to a polarizing photomask and an apparatus containing such a polarizing photomask. Unpolarized light from an illumination system is incident on the photomask. The photomask then both polarizes and diffracts the illumination light. As discussed in Matsumoto, the photomask

polarizes the illumination light according to TE polarization. TE polarization is effective for printing "line-and-space" patterns (see, col. 7, lines 39-44), as the directions of electric field vibration in TE polarization are orthogonal to each other. Additionally, Matsumoto mentions that an "isolated pattern" such as a single contact hole may be used, and that it is necessary to provide a polarizing member "which transmits only such beam that the electric vectors vibrate in a direction parallel to the side of the square at each side of the square" (see, col. 12, lines 29-36).

Shiraishi, on the other hand, places a polarizer in front of a non-polarizing mask merely for aligning light from a random source. The polarizer need not be any particular type of polarizer, and can even be removed if a coherence reducing member is used elsewhere in the projection optic (see, col. 10, lines 16-24). It would not be obvious to one of skill in the pertinent art to combine this polarizer with the invention of Matsumoto, since the mask in Matsumoto already includes a polarizer. Since the purpose of the polarizer in Shiraishi is merely to give the light some uniform polarization, there is no need to place it in front of another polarizer, as the effort would be duplicative. Additionally, the invention of Matsumoto can, at best, image an isolated contact hole, while Shiraishi discusses the need to image multiple contact holes. Combining Matsumoto with Shiraishi would not solve this need. For at least these reasons, Applicants respectfully submit that it would not have been obvious to one of skill in the pertinent art to combine Matsumoto and Shiraishi to produce the present invention.

Further, even if Matsumoto and Shiraishi could be combined, the combination still would not teach or suggest every element of the claimed invention. For example,

neither Matsumoto or Shiraishi, alone or in combination, teach or suggest "polarizing light according to a predetermined polarization pattern to produce a single polarized exposure beam having a polarization angle that varies across a cross-section of the beam relative to a center point in the beam" which is then output along an optical path toward a mask, as recited in claims 1, 11, 12, and 13. Since Matsumoto is directed toward a polarizing photomask, wherein polarization takes place within the photomask, polarized light is not and needs not be incident on the photomask. Shiraishi only discusses linear or circular polarization prior to the mask, since the optional polarizer prior to the mask is only used to align the light, not give the light any particularly useful qualities. The polarizer is also not required when the mask includes contact holes. As stated in Shiraishi, "the beams passing through the contact hole patterns on reticle and then reaching the [polarization control member] are also in a random polarization state" (see, col. 13, lines 15-18).

Shiraishi further discusses a coherence reducing means which includes polarizers. This coherence reducing means is not, however, placed in the optical path prior to the mask. Additionally, the coherence reducing means actually creates multiple light beams, each having different polarization directions so that the beams do not interfere (see, col. 4, lines 43-55). Thus, the light from the coherence reducing means in Shiraishi is not "a single polarized exposure beam" as recited in claims 1, 11, 12, and 13. Further, the polarization directions discussed in Shiraishi do not vary across a cross-section of the beam relative to a center point in the beam, as recited in claims 1, 11, 12, and 13.

The Examiner alleges that Shirashi discloses that the polarized light is either radially or tangentially polarized (see, Office Action, pg. 3). Applicants respectfully

disagree. Shiraishi does not refer at all to radial or tangential light. In fact, the sections cited to by the Examiner refer only to linear or circular polarization, which are very different from radial and tangential polarization. A cross-section of a beam of light that has been linearly or circularly polarized will not have polarization angles that vary relative to a center point in the beam.

Similarly, Matsumoto does not include a polarizer prior to the photomask. Additionally, Matsumoto shows how its photomask actually creates two different polarized light beams to increase the fundamental period of the pattern. Matsumoto states it is "necessary from the principle point of view to provide at least two kinds of polarizing members in the light transmitting portions of the transparent substrate so as to convert the illuminating light to the respective polarized light conditions which are perpendicular to each other and deliver them as such" (see, col. 14, lines 46-51).

The Examiner relies on Matsumoto's statement that "by arranging at the pupil plane of an imaging optical system any polarizing means which transmits light beams whose electric vectors vibrate in the direction parallel to the sides of the pattern, the contrast of the image can be enhanced" to show that any type of polarizing pattern may be used (see, Office Action, pg. 2). Applicants respectfully disagree. The type of polarizer, such as a wire polarizer or film polarizer, is different from a pattern that the polarizer may carry. Further, this statement does not mention radial, tangential, custom, or any other type of polarization having a polarization angle that varies across its cross-section.

Therefore, Matsumoto also does not teach or suggest producing "a single polarized exposure beam having a polarization angle that varies across a cross-section of the beam relative to a center point in the beam" as recited in claims 1, 11, 12, and 13.

For at least these reasons, Applicants respectfully submit that it would not be obvious to one of skill in the pertinent art to combine Matsumoto and Shiraishi, and that even if they could be combined, claims 1, 11, 12, and 13 are patentable over the combination. Reconsideration and withdrawal of the rejection of claims 1, 11, 12, and 13 are respectfully requested.

Claims 2-4 depend from claim 1, and are thus patentable for at least the reasons discussed with respect to claim 1. Reconsideration and withdrawal of the rejections of claims 2-4 are respectfully requested.

Claim 6 depends from claim 1, and is thus patentable for at least the reasons discussed with respect to claim 1. Additionally, neither Matsumoto nor Shiraishi teach or suggest pre-polarizing light at an illumination source, in addition to passing the light through a pattern polarizer, prior to illuminating the mask. Reconsideration and withdrawal of the rejection of claim 6 is respectfully requested.

Claim 7 depends from claim 1, and is thus patentable for at least the reasons discussed with respect to claim 1. Additionally, neither Matsumoto nor Shiraishi teach or suggest illuminating a mask with a single beam to produce an image that includes contact holes. Matsumoto discusses the possibility of imaging an isolated contact hole, but only if the polarizing member "transmits only such beam that the electric vectors vibrate in a direction parallel to the side of the square at each side of the square" (see, col. 12, lines 30-37). Therefore, Matsumoto neither teaches nor suggests illuminating a

contact hole image with a single beam "having a polarization angle that varies across a cross-section of the beam relative to a center point in the beam" as recited in claim 1, from which claim 7 depends.

Shiraishi only discusses imaging multiple contact holes in the context of multiple polarized beams of light, such that "after an imaging beam passes and is diffracted especially through a contact hole pattern in the reticle pattern, it is spatially split into two beams incoherent with each other in the pupil plane" (see, col. 4, lines 48-51).

Therefore, Shiraishi neither teaches nor suggests illuminating a contact hole image with a single beam "having a polarization angle that varies across a cross-section of the beam relative to a center point in the beam" as recited in claim 1. For at least these reasons, Applicants respectfully submit that claim 7 is patentable over Matsumoto in view of Shiraishi. Reconsideration and withdrawal of the rejection of claim 7 is respectfully requested.

Claims 9 and 10 depend from claim 1, and are thus patentable for at least the reasons discussed with respect to claim 1. Reconsideration and withdrawal of the rejections of claims 9 and 10 are respectfully requested.

Regarding claim 14, as discussed above with respect to claims 1, 11, 12, and 13, neither Matsumoto nor Shiraishi teach or suggest, alone or in combination, shaping light to produce a single exposure beam "wherein the polarization pattern has a polarization angle that varies across a cross-section of the polarization pattern relative to a center point in the polarization pattern" as recited in claim 14. Reconsideration and withdrawal of the rejection of claim 14 is respectfully requested.

Regarding claims 15 and 27, as discussed with respect to claims 1, 11, 12, and 13, Matsumoto and Shiraishi cannot be combined. Further, as discussed with respect to claim 7, even if combined neither Matsumoto nor Shiraishi teach or suggest a pattern polarizing device wherein the polarization pattern or beam has a polarization angle that varies across a cross-section of the polarization pattern or beam relative to a center point in the polarization pattern or beam, and a mask that includes contact hole features having a pitch as recited in claims 15 and 27. Thus, Applicants respectfully submit that claims 15 and 27 are patentable over Matsumoto in view of Shiraishi. Reconsideration and withdrawal of the rejection of claims 15 and 27 are respectfully requested.

Claims 17-19 and 21-25 depend from claim 15, and are thus patentable for at least the reasons discussed with respect to claim 15. Reconsideration and withdrawal of the rejections of claims 17-19 and 21-25 are respectfully requested.

Claims 28-31 depend from claim 27, and are thus patentable for at least the reasons discussed with respect to claim 27. Reconsideration and withdrawal of the rejections of claims 28-31 are respectfully requested.

Claim 5 stands rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Matsumoto in view of Shiraishi, and further in view of U.S. Pat. Appl. Pub. No. 2002/0176166 to Schuster ("Schuster"). Applicants respectfully traverse. Claim 5 depends from claim 1, and is thus patentable over Matsumoto in view of Shiraishi for at least the reasons discussed with respect to claim 1. Further, even if a combination of Matsumoto, Shiraishi, and Schuster is assumed for the sake of argument to be proper, Schuster fails to overcome the above-noted deficiencies of Matsumoto in view of Shiraishi. Therefore, the combination of Matsumoto, Shiraishi, and Schuster neither

teaches nor suggests every element of claim 5. For at least these reasons, Applicants respectfully submit that claim 5 is patentable over the combination of Matsumoto and Shiraishi. Reconsideration and withdrawal of the rejection of claim 5 is respectfully requested.

Claims 8 and 20 stand rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Matsumoto in view of Shiraishi, and further in view of U.S. Pat. No. 5,539,514 to Shishido et al. ("Shishido"). Applicants respectfully traverse. Claim 8 depends from claim 1, and is thus patentable over Matsumoto and Shiraishi for at least the reasons discussed with respect to claim 1. Further, even if a combination of Matsumoto, Shiraishi, and Shishido is assumed for the sake of argument to be proper, Shishido fails to overcome the above-noted deficiencies of Matsumoto and Shiraishi. Therefore, the combination of Matsumoto, Shiraishi, and Shishido neither teaches nor suggests every element of claim 8. Similarly, claim 20 depends from claim 15, and is thus patentable over Matsumoto and Shiraishi for at least the reasons discussed with respect to claim 15. Shishido fails to overcome their deficiencies. Therefore, the combination of Matsumoto, Shiraishi, and Shishido neither teaches nor suggests every element of claim 20. For at least these reasons, Applicants respectfully submit that claims 8 and 20 are patentable over the combination of Matsumoto, Shiraishi, and Shishido. Reconsideration and withdrawal of the rejections of claims 8 and 20 are respectfully requested.

Claim 16 stands rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Matsumoto in view of Shiraishi, and further in view of U.S. Pat. No. 5,467,166 to Shiraishi ("Shiraishi II"). Applicants respectfully traverse. However, as claim 16 has

been cancelled for other reasons, Applicants respectfully submit that the rejection of
claim 16 is rendered moot.

Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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